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Journal Pre-proof

The face mask-touching behavior during the COVID-19 pandemic: Observational study of public transportation users in the greater Paris region: The French-mask-touch study

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**The Face Mask-Touching Behavior During the COVID-19 Pandemic:
Observational Study of Public Transportation Users in The Greater Paris
Region: The French-Mask-Touch Study**

running title: *mask touching in public transportation*

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Abstract

Background: To limit the spread of the new coronavirus disease 2019 (COVID-19), the World Health Organization recommends the use of face mask as a part of the pandemic control strategy. It has published also “best practices” in which it advises to avoid touching the mask while wearing it. This might be challenging. The purpose of this study was to investigate the frequency of mask-touching behavior in public transportation.

Methods: Observational study using data collected in real life. This survey was conducted in subways and local trains of the greater Paris region, France, between May 4th and 25th, 2020. Public Transportation users were covertly observed. Demographic characteristics, type of mask and the main activity were collected by the investigator. The duration of observation, the frequency of touching face mask, hair and the uncovered area of the face were also recorded. Frequency of mask-touching per hour was determined.

Results: One hundred eighty two persons were observed. The median of estimated age [1st and 3rd interquartile] was 35 [30;45] years and 87 (48%) were women. One hundred forty three (79%) were wearing surgical mask. The median time of observation was 8 [4;12] minutes. During this period, 87 (48%) persons touched their mask 15 [7.5;30] times per hour of whom only two (8%) have used hydroalcoholic solution to disinfect their hands.

Conclusions: Mask touching is frequent and is rarely followed by hand disinfection. Actions regarding mask use should be taken to improve compliance.

Key words: Face mask; COVID-19; Face touch; Hand hygiene; Public transportation.

Introduction

The World Health Organization (WHO) declared the coronavirus outbreak a pandemic on March 11, 2020 (WHO, 2020). Infection by the SARS-CoV-2 virus, the virus that caused coronavirus disease 2019 (COVID-19), can occur through direct, indirect, or close contact with infected people through infected secretions such as saliva and respiratory secretions or their respiratory droplets (WHO, 2020). This can cause severe illness and may be fatal, especially in vulnerable populations including the elderly or those with medical comorbidities (Zhu et al., 2020).

So far, there are many aspects of the epidemic that are still mysterious, and there are no available effective vaccine or cures to slow SARS-CoV-2 transmission. The standards and transmission-based precautions such as stay-at-home measures, keeping social distance and washing/disinfecting hands using alcohol-based solutions remain crucial to disease mitigation (Jefferson et al., 2011).

Even though, health care policy makers' recommendations about generalizing mask usage have varied during the outbreak for several reasons (Feng et al., 2020). New available evidence suggests that the use of facial mask by the general population prevents the overall transmission of SARS-CoV-2 (Leung et al., 2020), (Cheng et al., 2020). After a shortage that lasted for weeks, face masks became progressively available in France for public at beginning of May, 2020. Like most developed countries, French authorities have encouraged the use of facial mask in closed environments such as stores and supermarkets. It became mandatory in public transportation starting of May 11th, 2020 (Légifrance, 2020). Recently, wearing face masks has been made mandatory in all enclosed public spaces and shops, and more recently in some outdoor public spaces in some towns and cities.

Facial masks are considered to be efficient in preventing SARS-CoV-2 spread and to avoid further outbreak. It stops virus transmission through respiratory droplets when an infected wearer coughs or sneezes, and by providing physical barrier between the mouth and nose of the wearer and potential contaminants in the surrounding environment (Liang et al., 2020), (Greenhalgh et al., 2020). Thus, their correct use is of particular importance and incorrectly worn masks may not confer effective protection. There are many types of masks, with differences in the effectiveness in terms of particles filtration. However, this effectiveness might be compromised by the discomfort and the itch related to the use of each type in real life. The WHO states that appropriate use and disposal are essential to ensure that they are

effective and to avoid any increase in transmission. It recommends also to clean hands using an alcohol-based hand rub or soap and water after removal or whenever a used mask is inadvertently touched (WHO, 2020). However, as for face-touching, mask-touching may be a spontaneous human behavior making the application of these recommendations challenging. In addition, potential discomfort during usage may also affect compliance.

There is no data in the literature on the frequency of mask-touching behavior among users of public transportation. Accordingly, we aimed to describe this behavior in users of public transportation in the greater Paris region.

Methods

Our observational cross-sectional study was conducted in the greater Paris region, France. Data were collected over a period of 3 weeks; between May 4th and 25th, 2020.

Public transportation users (subway and local trains) were covertly observed. Five evaluators have been trained and have contributed to collect the data during a total of 30 sessions. A standardized observation sheet was used to collect descriptive characteristics including the following: estimated age, gender, type of mask and if correctly worn, the length of hair, earphones, glasses, beard and the main activity during the ride were also collected. This sheet was also used to tally the frequency of hand-to-mask, to-face and to-hair contacts. The area of the face that was touched (forehead, ear, eyebrow, eye, nose and cheek) as well as the side (right or left) were also specified. The observation time was started by the getting in of the investigator or the observed person in the train or in the subway, and terminated by the getting off of the investigator or the observed person, which happened first. Position of the person, sitting down or standing up, was also recorded. The individuals were also watched for hand application of hydro-alcoholic rub both after mask touching or any surrounding surfaces. No more than two persons were observed simultaneously.

Ethical approval was not required as this was an observational study and no confidential data were recorded. The study is reported according to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Statistical analysis

The primary outcome was the frequency of facial mask touching. Secondary outcomes were: 1) the frequency of touching the uncovered areas of the face, hair and glasses, and 2) the

frequency of hand application of hydro-alcoholic rub. Data are described as frequency with percentages for categorical variables and median [interquartile range] for continuous variables. Continuous variables were compared using Wilcoxon rank-sum test. χ^2 test of independence was used to determine whether there is a statistically significant association between mask touching and categorical variables.. A p -value < 0.05 was considered significant. Statistica 12.0 software (Tulsa, Oklahoma, USA) was used for statistical analysis.

Results

A total of 182 persons were observed with a median of estimated age of 35 [30;45] years. Age groups distribution is presented in supplemental figure-1. Eighty seven (48%) were females. Details of demographic and profile of the individuals are presented in table-1. The majority; 143 (79%) were wearing surgical face mask. Fabric and FFP2 masks were observed in 31 (17%) and 2 (1.1%) respectively. The rest were wearing other type of masks. One hundred seventy one (94%) worn the mask correctly. Nose was uncovered in 7 (3.8%) cases. Nose and mouth both together were uncovered in 4 (2.2%) cases. Eighty seven (48%) were on their smartphone, 62 (34%) did not have any activity, 17 (9.3%) were talking on the phone, 9 (5%) were reading a paper and 7 (3.9%) were talking to another person.

The median observation time was 8 [4;12] minutes. The percentages of touching per region are presented in table-2. During this period of time, 87 (47%) have touched their mask at least once. Seventy four (41%) have touched at least one time the uncovered area of the face. For those who touched the external face of their mask, the frequency was of 15 [7.5;30] per hour. Regarding the touched parts of the face, 15% involved forehead, 8.8% the nose, 7.1% right side ear, 3.3% right side eyebrow, 6.6% right side eye and 8.2% right side, 3.8% left side ear, 5% left side eyebrow, 4.8% left side eye, and 6% cheek left side. Twenty two persons (12%) have inserted their hands under the mask and touched this covered part of the face. Twenty three persons (12%) have touched their hair. The frequency of touching these areas per hour is presented in figure-1. Moreover, 52 were wearing glasses, of whom 9 (17%) have touched them.

The observed individuals were classified to mask-touching and non-mask-touching groups and were compared. There was no difference in the duration of observation. The profile of the two groups was similar except for the observed activities (p -value = 0.028 for the Chi-squared test). The percentage of persons talking on the phone seems to be higher in the mask-touching group compared with the non-mask-touching group (14.9% and 4.2% respectively). In

contrast, the prevalence of persons reading papers seems to be lower in the mask-touching group compared with the non-mask-touching group (1.2% and 8.4 % respectively) (Supplemental table-1),

Applying alcohol-based handrub after mask touching was very low. Actually, only 2 persons used this hygiene method after they had touched their mask and only one after he had touched a metal bar.

Discussion

The current study showed that mask-face touching is frequent in the users of public transportation in the greater Paris region. Almost half of the mask wearers have touched their face masks at least one time in a median of time of 8 minutes. The frequency of mask touching was of 15 per hour. Similarly, face touching was frequent too. Hand hygiene was very low in this population.

The use of face masks may prevent uncontrolled spread of SARS-CoV-2 in the community and avoid a large resurgence of cases and overwhelming of health-care capacity. This is even more true when reasonable social distance could not be respected e.g. confined spaces with higher population density and less ventilation such as public transportation. There are currently many types of masks available. In our study the most frequent worn mask type was surgical.

Upper respiratory tract infections including SARS-CoV-2 may be avoided by not touching the face (Bertsch, 2010). However, and from a physiological point of view, touching face often occurs unintentionally. Itch is sensed by cutaneous nerve fibers called pruriceptors. Sensation of itch and the resulting reaction of scratching play a major role in protection against environmental insults. This may be also have a role in the neuroimmune communication process (Szepietowski et al., 2020). Thus this strategy, though important for infection control purposes, may be counterbalanced by a physiological/behavioral attitude represented by face and mask touching.

Furthermore, during mask usage, a variety of sensations and experiences, such as facial pressure, heat, friction or increased skin itchiness may lead to discomfort, thereby affecting compliance (Suen et al., 2020). In a recent study from China, Zuo et al. have documented itch induced by face masks in 15% of healthcare workers (Zuo et al., 2020). In an internet survey conducted in Poland, 20% of mask wearers reported having itch (Szepietowski et al., 2020).

Roberge et al. reported facial itch in 7% of the participants of a group of 20 healthy people wearing surgical masks during continuous walking on a treadmill at a low to moderate work rate for 1 hour. An additional 11% experienced skin irritation (Roberge et al., 2012). In another study conducted on 31 clinicians and 48 staff of the Cincinnati Area, Elder et al. have reported 19 times touching the T-zone area (eyes, nose, and mouth) in 2 hours (Elder et al., 2014). In another study, face-touching behavior was observed via videotape recording of 26 students. The study reported an average of 23 times per hour with 44% involved contact with a mucous membrane and 56% of contacts involved non-mucosal areas (Kwok et al., 2015). Nicas et al. have conducted a study on videotaped subjects performing office-type work in isolation from other persons during 3 hours. The authors reported an average total contact rate per hour of 15.7 with eyes, nostrils, and lips (Nicas and Best, 2008). The difference in the results between these studies may be explained by the fact that wearing mask in daily life is a common phenomenon in Asian countries. In addition to that, the main activities and settings were different. We have also included touching of the ears. To note, we have observed all touching behaviors including those with no itching (adjustment of the mask, touching or removing to talk on the phone...etc). In our study, persons who were on the phone were those who touched their mask the most. Difficulty in communication and speech intelligibility may explain this result as previously suggested (Suen et al., 2020). In contrast to an old observation (Dimond and Harries, 1984), we did not see any lateralization preference of face touching.

Increased tendency to touch the face while wearing a face mask might increase the risk of transmission and self-contamination. Also, use of face masks, avoiding touching the face, nose, eyes and mouth, and hand hygiene should be considered as complementary to other preventive measures that are recommended to reduce transmission of COVID- 19, including physical distancing, staying home when ill, and cleaning and disinfecting frequently touched surfaces. Meanwhile, the potential SARS-CoV-2 infection because of direct contact with a potentially contaminated mask can be mitigated by hand disinfection performed immediately after each touching. Our study, however, revealed low hand hygiene compliance. This might be improved by increasing visibility and accessibility of dispensers and sanitizer location (Cure and Van Enk, 2015).

Limitations of the study

This study has several limitations as we could not have a comparator group with no mask wearers. Persons with dry skin or some facial dermatoses are vulnerable to develop skin reactions to masks resulting in more itching. We could not investigate this point as we didn't had access to medical history of the transport users. A case of allergic contact dermatitis caused by elastic bands from FFP2 masks have been also reported (Navarro-Trivino et al., 2020). Face mask frequently causes discomfort on ear lobe. This may increase touching of this area. We could not confirm this hypothesis as we did not have a comparator group with no mask wearers. The limited number of the non-surgical masks users did not allow us to determine if there is an effect of the type of mask on the frequency of touching. The frequency of itch might vary with the duration of face mask wearing. We could not determine for how long the observed person was wearing his mask. The observations sessions were performed during peak-hours which are known to be concomitant with elevated concentrations of air pollution. We can hypothesize that this might cause more itching and thus higher frequency of mask touching compared to off-peak hours. Other limitations of this study are the small number of individuals observed, the limited observation time, and the human observational error that may bias the results.. The study was performed in subways and trains in Paris area. Thus, the results cannot be generalized without cautions to other populations and other different settings.

Conclusions

The findings of this study demonstrate that the use of face mask is not optimal in the general population. Many individuals touched their mask with a frequency as high as 15 times per hour. Hand hygiene with an alcohol-based hand rub is rarely performed after mask touching. Consequently, further effort should be exerted to improve general public awareness regarding the proper use of face mask. Messages and recommendations regarding face masks use, with avoiding touching them when possible, and hand disinfection, along with barrier measures, should be widely diffused. This could be reached through instruction sheets in public transportation and public areas, broadcast audio messages diffused in the subway and train stations...etc. Other available resources such as media platforms as well as social networks should be used as they might be helpful to communicate with the general population. Other actions such as making hydroalcoholic gel available for sale in train and stations (shops, automatic dispensers) would help in slowing the spread of COVID-19. Our study could be relevant to other settings such as public transportations in other cities and countries, but also other crowding conditions such as markets, airports, schools, universities, ...etc. Further large

216 studies in other public transportation systems around the world and other sittings are
217 warranted. Future studies after implementation of the suggested interventions would
218 determine their effectiveness on changing the mask touching behavior and the frequency of
219 hydroalcoholic gel use.

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Conflicts of Interest: The authors declare no conflict of interest for this study.

Legends

Figure-1: Frequency per hour of touching mask, covered an uncovered area of the face, hair (head), and glasses.

Supplemental Figure-1: Bar chart showing the estimated age groups of the observed public transportation users.

297 **Table-1: General characteristics of the observed individuals.**

Variables	(N=182)	
Demographic	Estimated age, median [Q1;Q3], (years)	35 [30;45]
	Men, n (%)	87 (47.8)
	Length of hair	
	-shaved, n (%)	15 (8.2)
	-short, n (%)	86 (47.3)
	-semi-long hair, n (%)	48 (26.4)
	-long hair, n (%)	21 (11.5)
	-covered, n (%)	12 (6.6)
	Beard (men)*, n (%)	25 (26.3)
	Earphones, n (%)	67 (36.8)
	Glasses, n (%)	52 (28.6)
Observations	Time median [Q1;Q3], (minutes),	8 [4;12]
	Transportation mode	
	-subway, n (%)	148 (81.3)
	-train, n (%)	34 (18.7)
	Sitting, (%)	177 (97.3)
	Part of the day #	
	-morning, n (%)	81 (47.4)
	-midday, n (%)	26 (15.2)
	-evening, n (%)	64 (37.4)
Mask	Type of mask	
	-surgical, n (%)	143 (78.6)
	-fabric, n (%)	31 (17)
	-FFP2, n (%)	2 (1.1)
	-other types, n (%)	6 (3.3)

Mask position	Correctly worn, n (%)	171 (97)
	Nose exposed, n (%)	7 (3.8)
	Nose and mouth exposed, n (%)	4 (2.2)
During observation	Alone, n (%)	170 (93.4)
	Main activity	
	<i>-on smart phone, n (%)</i>	87 (47.8)
	<i>-on the phone, n (%)</i>	17 (9.3)
	<i>-reading paper, n (%)</i>	9 (5)
	<i>-talking, n (%)</i>	7 (3.9)
	<i>-nothing, n (%)</i>	62 (34)

298 ***on 95 men, # missing data =11**
299 **Q1: first quartile, Q3: third quartile**
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Table-2: Frequency of touching mask, covered and uncovered area of the face, hair (head), and glasses.

Touched area		
Mask	External face, n (%)	87 (47)
	Frequency/h	15 [7.5;30]
Covered area	(mouth/nose), n (%)	22 (12.1)
	Frequency/h	10 [16;15]
Uncovered area	Total, n (%)	74 (40.6)
	Frequency/h	12 [6.7;20]
Hair (head)	Total, n (%)	23 (12.3)
	Frequency/h	15.0 [7.1;23.3]
Glasses (n=52)	Total, n (%)	9 (17.3)
	Frequency/h	7.5 [6.6;15]

Supplemental Table-1: Comparison between mask-touching and non-mask-touching groups.

Variables		Mask touching	Non mask touching	p
Estimated age	<i>Median [Q1;Q3], (years)</i>	35 [27;45]	40 [30;45]	0.602
Gender	<i>men, n (%)</i>	48 (55.2)	47 (49.5)	0.591
	<i>women, n (%)</i>	39 (44.8)	48 (50.5)	
Position	<i>sitting, n (%)</i>	85 (97.70)	92 (96.84)	0.723
	<i>standing-up, n (%)</i>	2 (2.30)	3 (3.16)	
Length of hair	<i>shaved, n (%)</i>	6 (6.90)	9 (9.47)	0.244
	<i>short, n (%)</i>	43 (49.43)	43 (45.26)	
	<i>semi-long hair, n (%)</i>	24 (27.59)	24 (25.26)	
	<i>long hair, n (%)</i>	6 (6.90)	15 (15.79)	
	<i>covered, n (%)</i>	8 (9.20)	4 (4.21)	
Beard (men)*	<i>with, n (%)</i>	16 (33.33)	9 (19.15)	0.116
	<i>without, n (%)</i>	32 (66.67)	38 (80.85)	
Earphones	<i>with, n (%)</i>	37 (42.53)	30 (31.58)	0.126
	<i>without, n (%)</i>	50 (57.47)	65 (68.42)	
Glasses	<i>with, n (%)</i>	22 (25.29)	30 (31.58)	0.348
	<i>without, n (%)</i>	65 (74.71)	65 (68.42)	
Type of Mask	<i>surgical, n (%)</i>	67 (77.01)	76 (80.00)	0.427
	<i>tissue, n (%)</i>	14 (16.09)	17 (17.89)	
	<i>fabric, n (%)</i>	3 (3.45)	0 (0)	
	<i>FFP2, n (%)</i>	1 (1.15)	1 (1.05)	
	<i>other types, n (%)</i>	2 (2.30)	1 (1.05)	
Mask position	<i>correctly worn, n (%)</i>	78 (89.66)	93 (97.89)	0.062
	<i>nose exposed, n (%)</i>	6 (6.90)	1 (1.05)	
	<i>nose and mouth exposed, n (%)</i>	3 (3.45)	1 (1.05)	
Main activity	<i>on smart phone, n (%)</i>	41 (47.13)	46 (48.42)	16
	<i>on the phone, n (%)</i>	13 (14.94)	4 (4.21)	
	<i>reading paper, n (%)</i>	1 (1.15)	8 (8.42)	

<i>talking, n (%)</i>	4 (4.60)	3 (3.16)	
<i>nothing, n (%)</i>	28 (32.18)	34 (35.79)	0.028

306

307 *N= 95,

308 Q1: first quartile, Q3: third quartile

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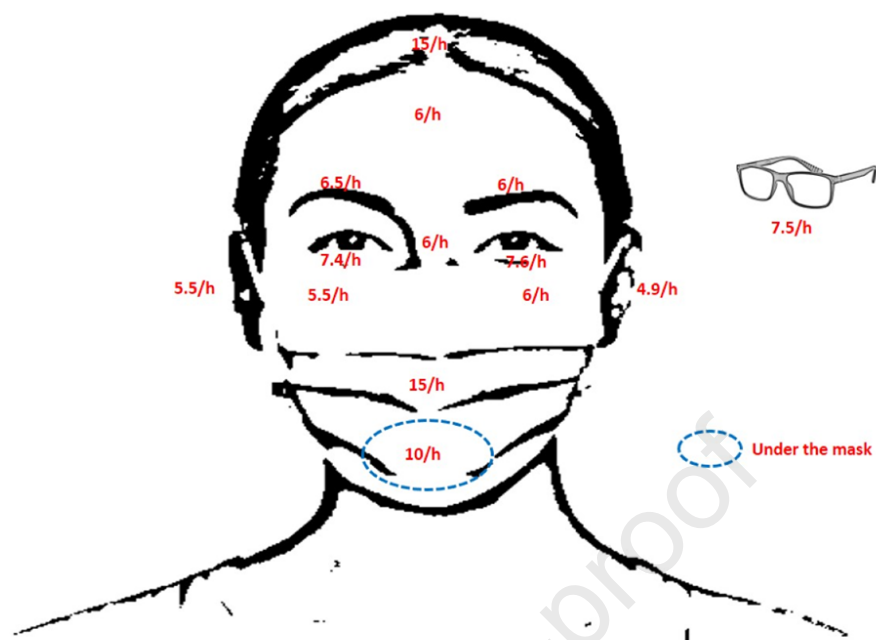


Figure-1

Highlights

- The use of facial mask by the general population might prevent the overall transmission of SARS-CoV-2.
- The WHO recommends the use of face masks as part of the pandemic control strategy. It advises to avoid touching them.
- Face touching is a common behavior. However, there is no data on the frequency of mask touching.
- Our study shows that mask touching is frequent in the general population and it is rarely followed by application of alcohol-based handrub.
- Further effort should be taken to improve public transportation users' awareness regarding the proper use of face masks.

Author statement

AG and EM contributed to the study conceptualization and design. AG, ET, AM, CG and HNNC contributed to data collection. AG and EM contributed to data analysis, data interpretation and manuscript preparation. All authors read and approved the final version. AG warrants that the final manuscript and authorships accurately reflect the contributions of all individuals who participated substantially in the study.

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